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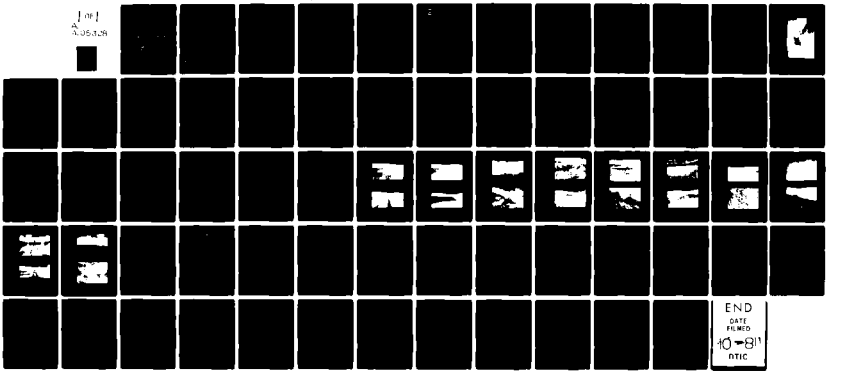

LEVEL II

OSAGE-GASCONADE BASIN

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LAKE TIMBER RIDGE DAM

GASCONADE COUNTY, MISSOURI

MO. 30762

AD A105328

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
... Serving the Army
... Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE, 1979

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LAKE TIMBER RIDGE DAM

GASCONADE COUNTY, MISSOURI

MO. 30762

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

JUNE, 1979

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Lake Timber Ridge Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of Lake Timber Ridge Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass the Probable Maximum Flood.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY SIGNED 17 DEC 1979
Chief, Engineering Division Date

APPROVED: SIGNED 17 DEC 1979
Colonel, CE, District Engineer Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Lake Timber Ridge Dam
State Located	Missouri
County Located	Gasconade County
Stream	Tributary Pinoak Creek
Date of Inspection	May 16, 1979

Lake Timber Ridge Dam was inspected by an interdisciplinary team of engineers, ~~from Hoskins-Western-Sonderegger, Inc.~~ The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately three miles downstream of the dam. Within the damage zone are two or three dwellings, several outbuildings, U.S. Highway 50, Highway BB and two bridges.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for an intermediate dam having a high hazard potential. The probable Maximum Flood is the appropriate spillway design flood. The spillways will pass the 100-year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 14% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Recommendations presented in Section 7 of this report relative to minimizing or eliminating the potential for overtopping of the dam should be pursued on a high priority basis.

This dam appears to be in good condition and structurally stable. However, seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams", including appropriate earthquake loadings should be obtained in the near future.

Action should be initiated as soon as possible on measures to evaluate and/or correct the following minor deficiencies observed during the inspection: tree growth on the upstream face of the dam and in the entrance to the left spillway; deterioration of concrete around the culverts in the left spillway (if this spillway is not modified by other corrective measures); and the quantity and clarity of seepage effluent just downstream from the dam.

Maintenance of this dam is generally satisfactory except as noted above.

Rey S. Decker
E-3703

Gordon Jamison

Gordon Jamison

Harold Ulmer

Garold Ulmer
E-4777

H. P. Hoskins

Harold P. Hoskins
Chairman of Board
Hoskins-Western-Sonderegger, Inc.
E-8696

PHOTO NO. 1
OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE TIMBER RIDGE DAM - MO 30762
GASCONADE COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Lake Timber Ridge Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earthfill approximately 900 feet in length and about 43 feet in height. It is located in rolling hills with sharply incised valleys cut into limestone and shale formations.

(2) The principal spillway is uncontrolled and consists of a cut through limestone and shale bedrock on the left abutment.

(3) An uncontrolled vegetated earth emergency spillway is cut through the right abutment.

(4) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the west central portion of Gasconade County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the S½ of Section 16, T43N, R6W. The lake formed behind the dam is shown in the S½ of Section 16, T43N, R6W, and the N½ of Section 21, T43N, R6W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the intermediate size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends approximately three miles downstream of the dam. Within the damage zone are two or three dwellings, several outbuildings, U.S. Highway 50, Highway BB and two bridges.

e. Ownership. The dam is owned by Lake Timber Ridge Owners Association; James Patley, Trustee, 48 Park Charles Blvd. South, St. Peters, Mo. 63376.

f. Purpose of Dam. The dam impounds a recreational lake of about 680 acre-feet ±.

g. Design and Construction History. No design or construction history were available.

h. Normal Operating Procedure. There are no operating facilities for this dam.

1.3 PERTINENT DATA

a. Drainage Area. 616 acres (0.96 square miles).

b. Discharge at Damsite.

(1) All discharge at the damsite is through one or both earthen spillways which are located at each end of the dam. The left (west) spillway is restricted by 5-12" culverts capped by concrete.

(2) Estimated maximum flood at damsite -- unknown.

(3) The principal spillway capacity varies from 0 cfs at elevation 655.3 feet to 125 cfs at the crest of the emergency spillway (elevation 657.2 feet).

(4) The emergency spillway capacity varies from 0 cfs at its crest elevation 657.2 feet to 19 cfs at elevation 658.1 feet (minimum top of dam).

(5) Total spillway capacity at the minimum top of dam is 431 cfs ±.

c. Elevations (feet above M.S.L.).

(1) Top of dam (min. elev.) - 658.1 ft.
(2) Principal spillway crest - 655.3 ft.
(3) Emergency spillway crest 657.2
(4) Streambed at centerline - 615 ±
(5) Maximum tailwater - unknown

d. Reservoir. Length (feet) of maximum pool - 2,500 ±.

e. Storage (Acre-feet).

(1) Top of dam - 810 ±
(2) Principal spillway crest - 680 ±

f. Reservoir Surface (Acres).

(1) Top of dam - 47 ±
(2) Principal spillway crest - 12 ±

g. Dam.

(1) Type - earthfill
(2) Length - 900 ft. ±
(3) Height - 43 ft. ±
(4) Top width - 16 ft.
(5) Side slopes
  (a) Downstream - 2.3H on 1V (measured)
  (b) Upstream - 2.3H on 1V (measured on exposure)
(6) Zoning - unknown
(7) Impervious core - unknown
(8) Cutoff - unknown
(9) Grout curtain - unknown
(10) Wave protection - limestone riprap

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

(a) Type - Uncontrolled, excavated earth and rock through the left abutment.

(b) Crest (channel) elevation - 655.3 ft. ±
Culvert invert (U.S.) - 654.4 ft. ±

(c) Length - 250 ft. ±

(2) Emergency

(a) Type - Uncontrolled, vegetated earth cut through the right abutment.

(b) Control section - parabolic shape, about 12 feet in length with top width of about 50 feet.

(c) Crest elevation - 657.2 ft. ±

(d) Upstream channel - well vegetated with some limestone riprap at inlet end, approximately 20 feet in length with slope of 10%.

(e) Downstream channel - well vegetated. Outlets adjacent to right abutment trough. Exit channel on 6% slope.

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available.

2.3 OPERATION

No data were available on spillway operation.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusion of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Timber Ridge Lake Dam was made on June 27, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R. S. Decker, Geotechnical; Gordon Jamison, Hydrology; Garold Ulmer, Civil Engineer.

b. Dam.

(1) Geology and Soils (abutment and embankment). Upland and valley slope soils consist of thin loess overlying residual cherty clays derived from limestone and shale. Stratified beds of limestone and silty clay shale are exposed on the left abutment (spillway cut, see photo 8). The limestone is fractured but no solution channels or vugs were observed. These limestones and shales are probably part of the Jefferson City-Cotter formation. Massive coherent limestone is exposed in the creek channel immediately downstream from the dam. This would indicate that foundation materials under the dam probably consist of a relatively thin deposit of plastic alluvium over bedrock. The damsite area is located between the Cuba fault, Kruegers Ford Anticline and the Pershing-Bay-Gerald Anticline. However, no surface indication of structural deformation was observed at the site. Many seep and spring outcrops were observed in the general area. Auger borings on the embankment showed plastic silty clay (CL or CH) materials to depths of 2 feet.

(2) Upstream slope. The upstream slope is well riprapped with good limestone having nominal size of 8 to 12 inches. The slope is well vegetated above the riprap. A few small trees and shrubs were observed growing along the upper edge of the riprap. No significant erosion, slides or deformations were noted on the slope.

(3) Crest. The crest serves as a gravel surfaced roadway for access to the west side of the reservoir. The crest is well vegetated with adapted grasses adjacent to the roadway. The crest profile is somewhat irregular but no slides, cracks or deformations were noted on the crest.

(4) Downstream slope. The downstream slope is well vegetated with adapted grasses. No cracks, slides, rodent holes or deformations were observed. A spring area is located about 20 feet downstream from the toe of the dam downstream from Station 5+00 ±. The spring appears to emerge through coarse gravel material in the old stream channel bottom. (It was impossible to penetrate the bottom materials with a hand auger). Cobble and gravel are exposed along the toe of the dam in the area adjacent to the spring area. It appears that the outlet channel for the spring has been excavated and it is possible that the spring may be the discharge from a toe drain. (See photos 15 and 16) Discharge from the spring was estimated at 1 gal/min. It was clear and iron stained. Another seepy area was noted downstream from Station 7+65 to 8+15. This seep occurs in the old channel downstream from the toe. No water was flowing and it was clear. A seep area also occupies the upper end of the right abutment trough. Some standing water was observed in this area. Seep in the right abutment trough probably originates through the limestone abutment materials. Total seepage discharge in the old channel, some 100 to 150 feet downstream from the dam was estimated at 3 to 4 gal/min. (See photo 21)

(5) Miscellaneous. The dense vegetation and the CL or CH materials observed in the dam indicate that this dam would withstand significant overtopping without serious damage.

c. Appurtenant Structures.

(1) The principal spillway consists of a channel cut through limestone and shale on the left abutment. The approach channel and control section are open with limestone bedrock exposed in most of the bottom. The lower end of the control section is restricted by a roadway across the spillway consisting of a concrete slab over five concrete pipe culverts 12 inches in diameter. Some deterioration was noted in the concrete filleting around the upstream and downstream ends of the culverts. (Photos 10 and 12) The exit channel is eroded through CL-CH Soil and Shale and outlets over a near vertical drop of 8 feet ± where the channel bottom has stabilized on limestone bedrock (photo 11). Discharges from this spillway would not encroach upon the dam. The reservoir level was slightly below the inlet elevation of the spillway when inspected.

(2) The emergency spillway consists of a shallow earth channel excavated through the right abutment. The inlet section is riprapped with a few small trees growing at the water edge. The control section and outlet channel are densely vegetated with adapted grasses. The outlet channel drops off onto the stable abutment some 100 feet downstream from the control section. No erosion was noted in the spillway. The water level was approximately 2 feet below the control elevation when inspected. Trash in the inlet section indicated that the reservoir level had been up to within 8 to 12 inches of the control elevation.

(3) Drawdown facilities. No drawdown facilities were observed for this dam.

d. Reservoir Area. No significant erosion was observed around the reservoir area.

e. Downstream channel. The stream channel is overgrown with trees and shrubs. The channel bottoms on massive, competent limestone bedrock.

3.2 EVALUATION

There does not appear to be any serious potential of failure of this structure. The embankment slopes are somewhat steeper than normally used for a dam of this height. Seepage at the downstream toe apparently moves through erosion resistant foundation bedrock

and cherty gravels and has no apparent adverse affect on the integrity of the dam. The roadway culverts and slab across the principal spillway would cause some impedance in maximum discharge. The slab is 2 feet below the top of dam and 1 foot below the emergency spillway crest elevation. The dam and appurtenances appear to be well maintained with exception of the few small trees and shrubs on the upstream face and deterioration of concrete around the culverts in the spillway.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

Maintenance is generally satisfactory. The small trees and shrubs on the upstream face should be removed and measures taken to prevent recurrence. Concrete deterioration in the spillway roadway culvert area could be repaired but does not appear to be significant.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

There does not appear to be any serious potential of failure of this structure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were found for this dam.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Bland, Missouri 15 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.

c. Visual Observations.

(1) An almost vertical headcut exists in the principal (left) spillway approximately 85 ft. below the culvert and weir control. It is eroded down to bedrock and is approximately 8 ft. deep. This should pose no threat to the dam.

(2) Some erosion has occurred to both the upstream and downstream ends of the concrete cap covering the culverts in the principal spillway channel.

(3) Emergency (right) spillway appears to be in satisfactory condition.

d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping. The spillways will pass the 100-year flood as well as 14% of the probable maximum flood without overtopping. The dam should withstand significant overtopping without serious damage. The results of the routings through the dam are tabulated in regards to the following conditions.

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	Freeboard Top of Dam Min. Elev. 658.1	Time Dam Overtopping Hr.
100 Yr.	700	280	657.8	0.3	-
1/2 PMF	4900	4400	659.6	-1.5	5+
PMF	9900	9100	660.4	-2.3	7-
0.14 PMF	1400	450	658.1	0	-

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. There are no visual indications of structural instability. In fact, the structure looks good. Additional studies would be required to determine the effects of foundation seepage, steeper than normal side slopes and of overtopping on the structural stability of the dam. It would appear that overtopping would not seriously impair the structural stability.

b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post Construction Changes. The inspection team is not aware of any post construction changes for this structure.

e. Seismic Stability. This dam is located near Seismic Zone 2, in an area of previous diastrophic activity. Additional studies would be required to determine the seismic activity in the area and the effect of such activity on the stability of this structure.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. There does not appear to be a serious potential of failure of this dam from the standpoint of structural stability. However, seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

According to the approximate data used for analyses in Section 5, the dam will not be overtopped by the 100-year flood but will be overtopped to a depth of 2.3 feet for about 7 hours by the Probable Maximum Flood. The effects of much overtopping on the structural and erosional stability of the dam is not known, but it appears that it would not cause serious damage to the structure.

b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

c. Urgency. The item regarding spillway capacity recommended in paragraph 7.2.a should be pursued on a high priority basis.

d. Necessity for Phase II. Phase II investigation is not considered necessary.

e. Seismic Stability. This dam is located near Seismic Zone 2 in an area of recognized faults and geologic formational distortions. Additional studies would be required to determine the seismic stability of this structure.

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) Additional information should be obtained on the hydrologic characteristics of the watershed and on the topographic characteristics of the reservoir area to determine the increase in the height of the dam or the size of the spillways that is necessary

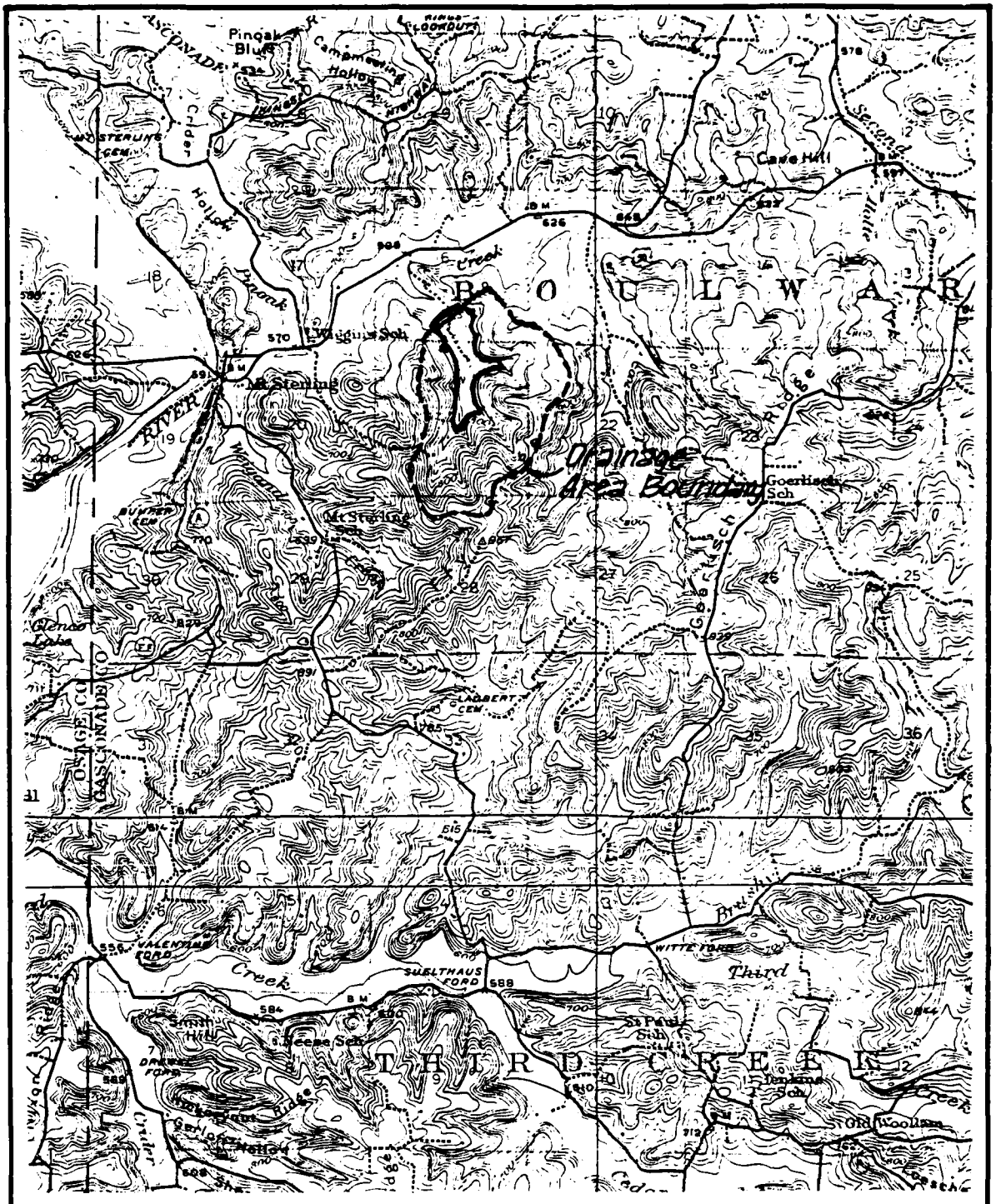
to pass the Probable Maximum Flood without overtopping the dam.

(2) The quantity and clarity of the seepage effluent should be monitored at periodic intervals and the data made a part of the records of this dam.

(3) The services of an engineer experienced in the design of dams should be obtained to evaluate the present reservoir storage capacity, to provide seepage and stability analyses of the present dam including potential seismic forces, and to design protective measures, including the seepage monitoring system, as required.

b. O & M Procedures. Present maintenance appears to be good. However, a program of periodic inspection should be initiated and implemented with measures to remove and control trees and shrubs on the upstream slope and to repair and maintain the concrete in the principal spillway.

APPENDIX A
MAPS



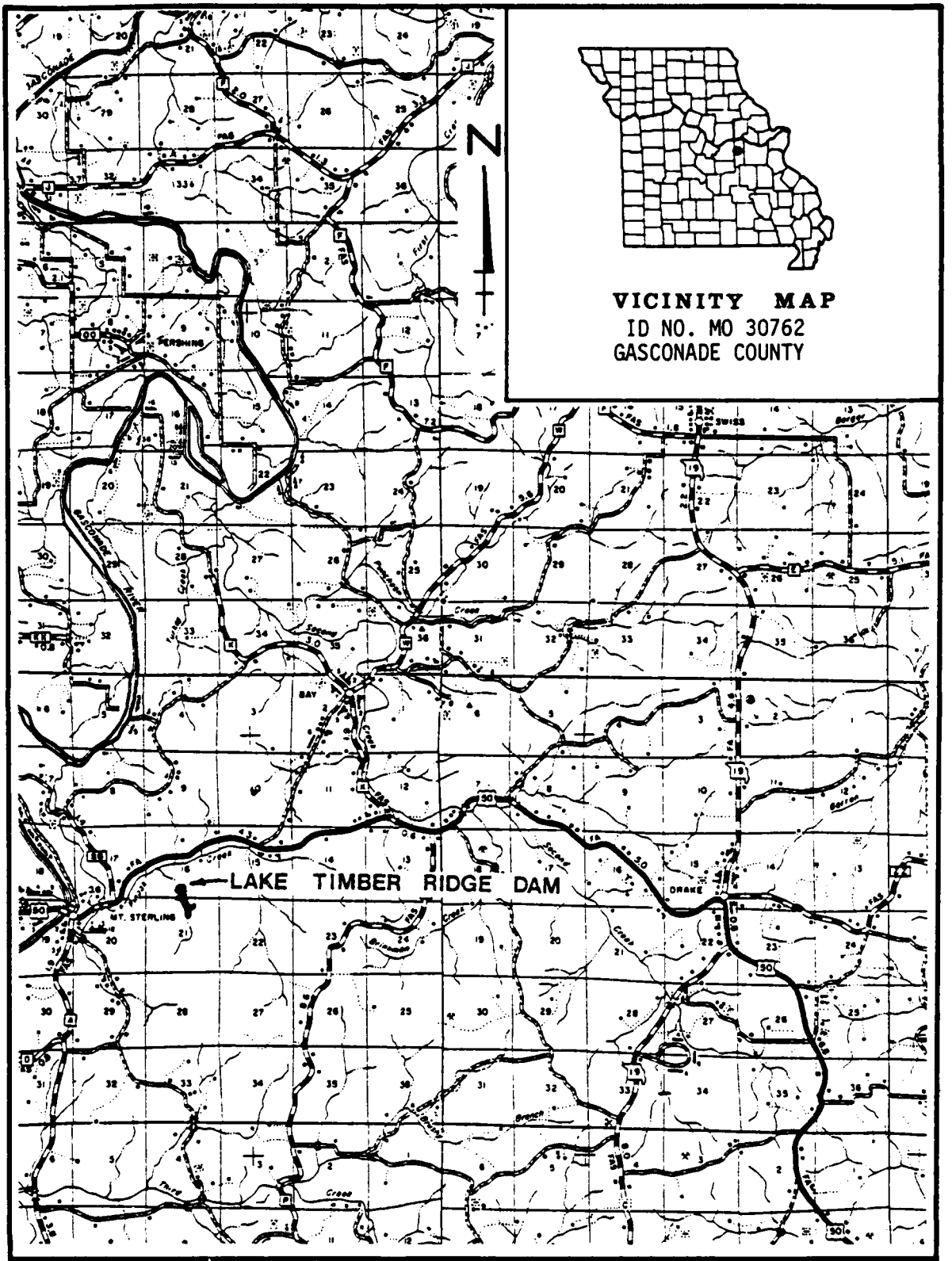
VICINITY TOPOGRAPHY

LAKE TIMBER RIDGE DAM

GASCONADE COUNTY, MO.

MO. 30762

PLATE A-1


N
VICINITY MAP
ID NO. MO 30762
GASCONADE COUNTY
LAKE TIMBER RIDGE DAM
PERSHING
MT. STERLING
DRAKE
Scale in miles
0 1 2 3 4 5
LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS

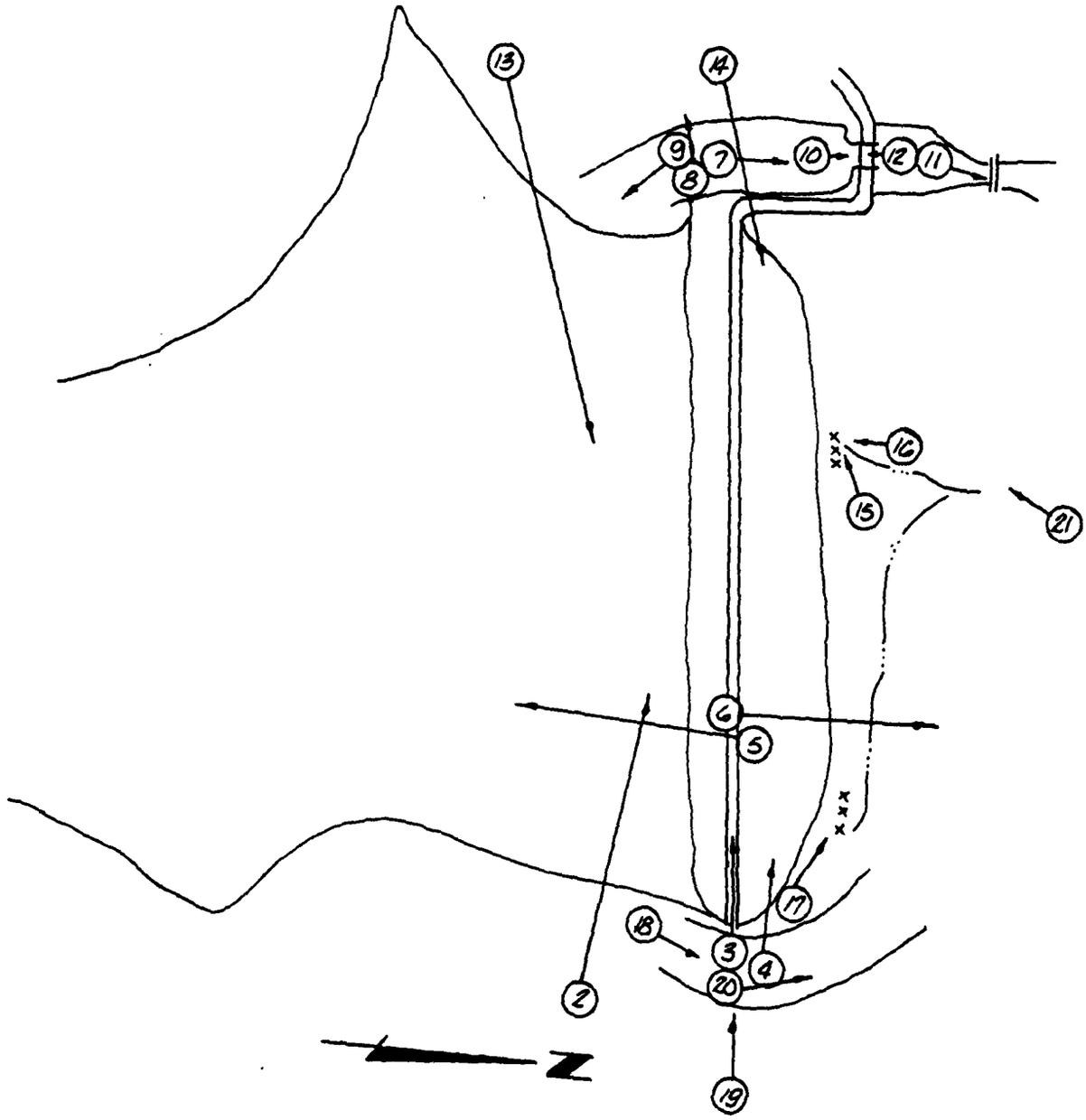


PHOTO INDEX

LAKE TIMBER RIDGE DAM

GASCONADE COUNTY, MISSOURI

MO. 30762

PLATE B-1

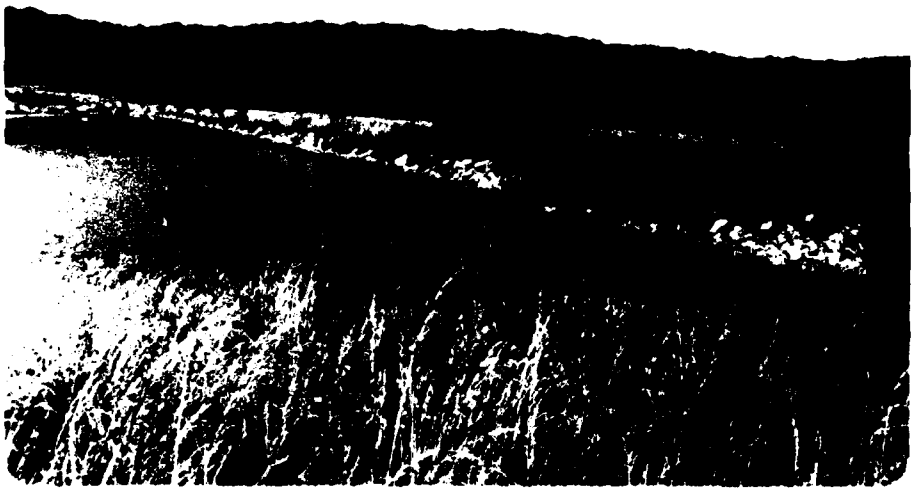


PHOTO NO. 2 - UPSTREAM FACE FROM RIGHT ABUTMENT

PHOTO NO. 3 - CREST FROM RIGHT END

PHOTO NO. 4 - DOWNSTREAM SLOPE FROM RIGHT END

PHOTO NO. 5 - UPSTREAM FROM STA. 4 + 00

PHOTO NO. 6 - DOWNSTREAM FROM STA. 4 + 00. SPRING IN LEFT CENTER

PHOTO NO. 7 - DOWNSTREAM IN SPILLWAY ON LEFT SIDE

PHOTO NO. 8 - LIMESTONE AND SHALE FORMATIONS IN LEFT ABUTMENT

PHOTO NO. 9 - UPSTREAM IN LEFT SPILLWAY

PHOTO NO. 10 - LOOKING DOWNSTREAM AT LEFT SPILLWAY CONTROL SECTION

PHOTO NO. 11 - DOWNSTREAM FROM LEFT SPILLWAY CONTROL SECTION. 6 TO 7 FOOT HEAD-CUT TO BEDROCK

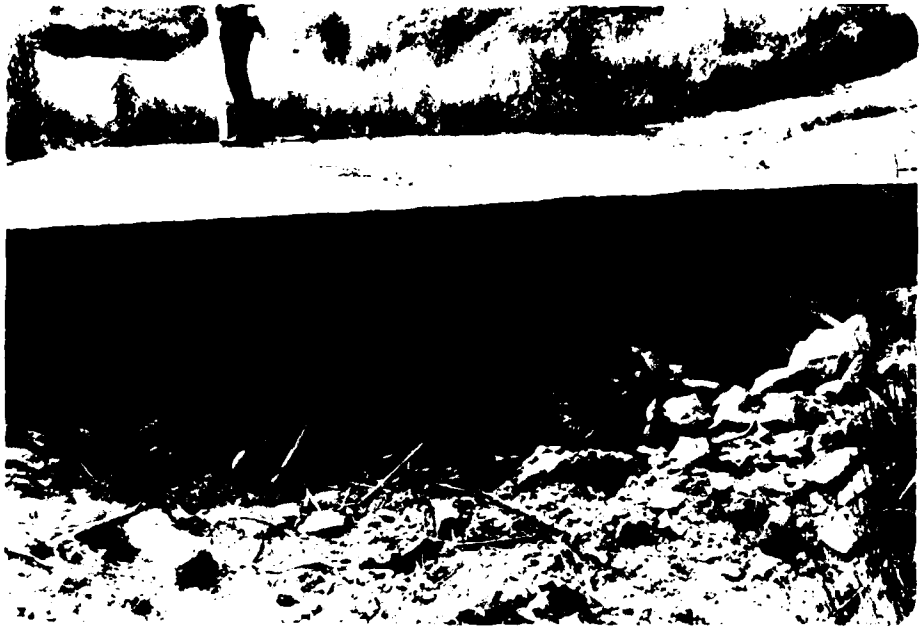


PHOTO NO. 12 - DOWNSTREAM SIDE OF LEFT SPILLWAY CONTROL SECTION

PHOTO NO. 13 - OVERVIEW FROM HIGH ON LEFT ABUTMENT

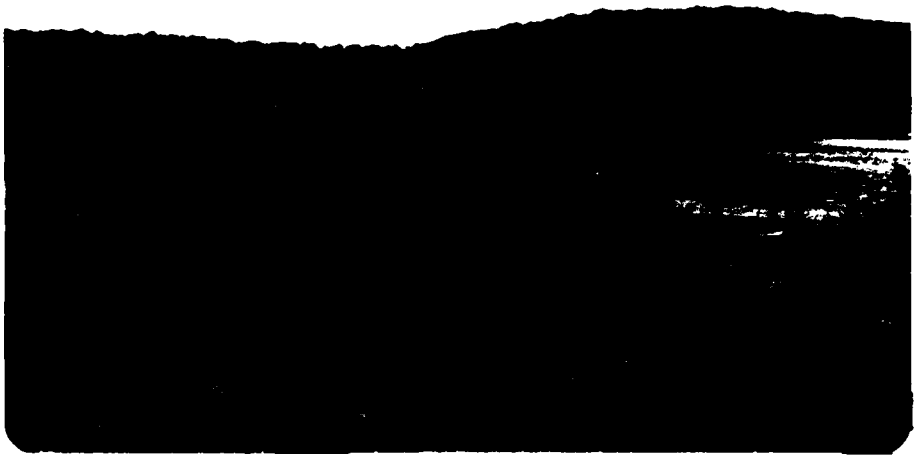


PHOTO NO. 14 - CREST, DOWNSTREAM SLOPE AND LEFT SPILLWAY FROM LEFT ABUTMENT

PHOTO NO. 15 - SPRING AREA OUTCROPPING 20' ± DOWNSTREAM FROM TOE

PHOTO NO. 16 - LOOKING UPSTREAM AT SPRING AREA

PHOTO NO. 17 - SEEP AREA IN RIGHT ABUTMENT TROUGH

PHOTO NO. 18 - DOWNSTREAM IN RIGHT SPILLWAY

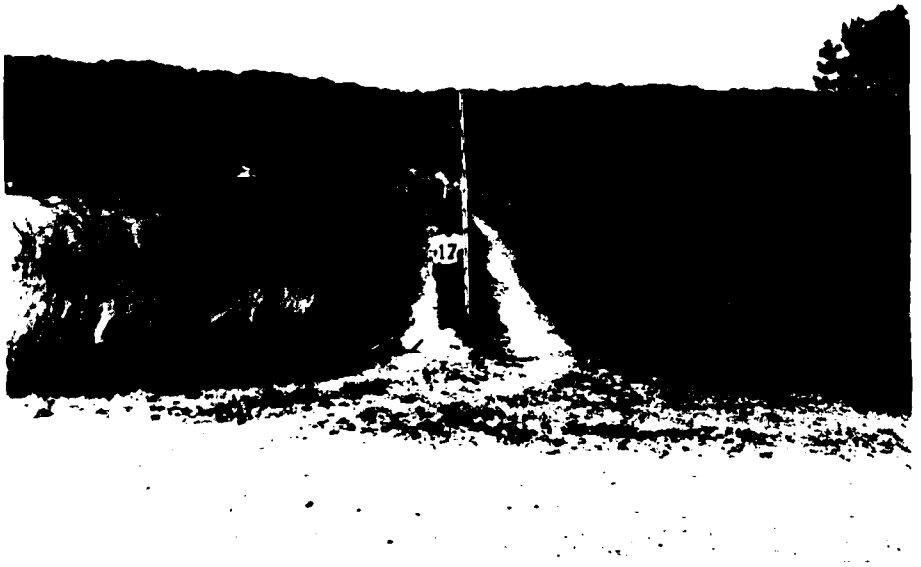


PHOTO NO. 19 - LOOKING ACROSS RIGHT SPILLWAY AT CREST OF DAM

PHOTO NO. 20 - LOOKING DOWNSTREAM IN RIGHT SPILLWAY

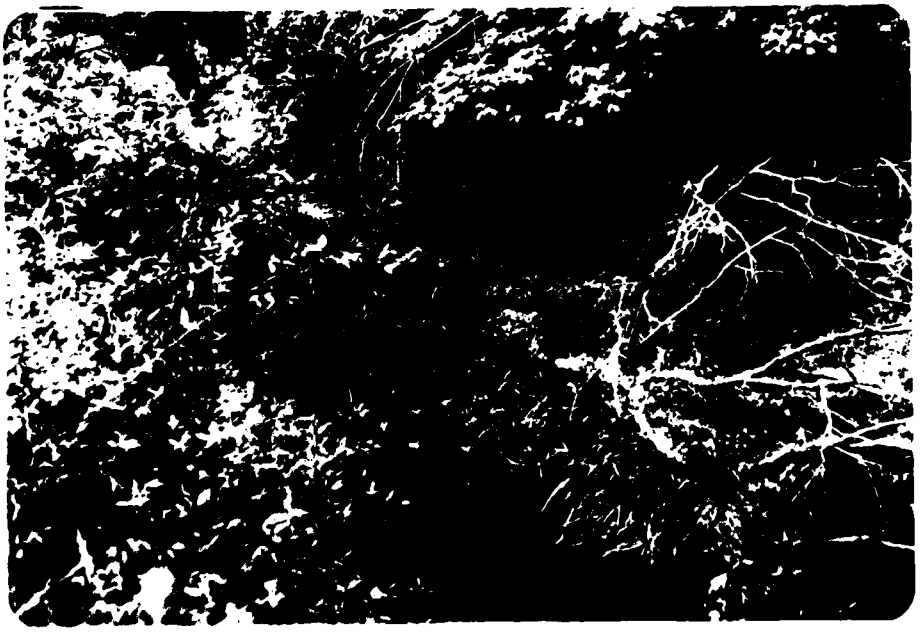


PHOTO NO. 21 - SEEP IN OLD CHANNEL BELOW DAM

APPENDIX C
PROJECT PLATES

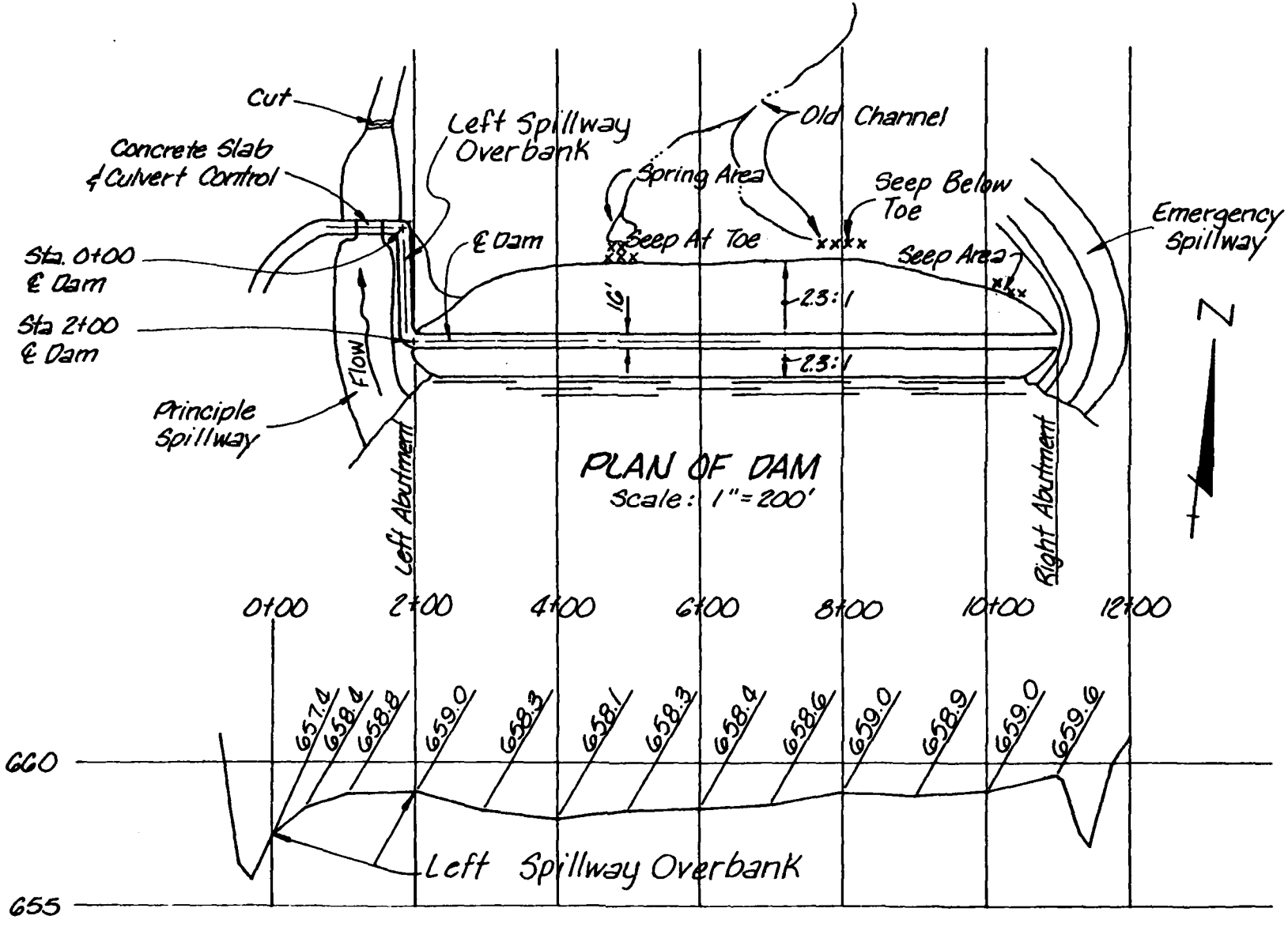
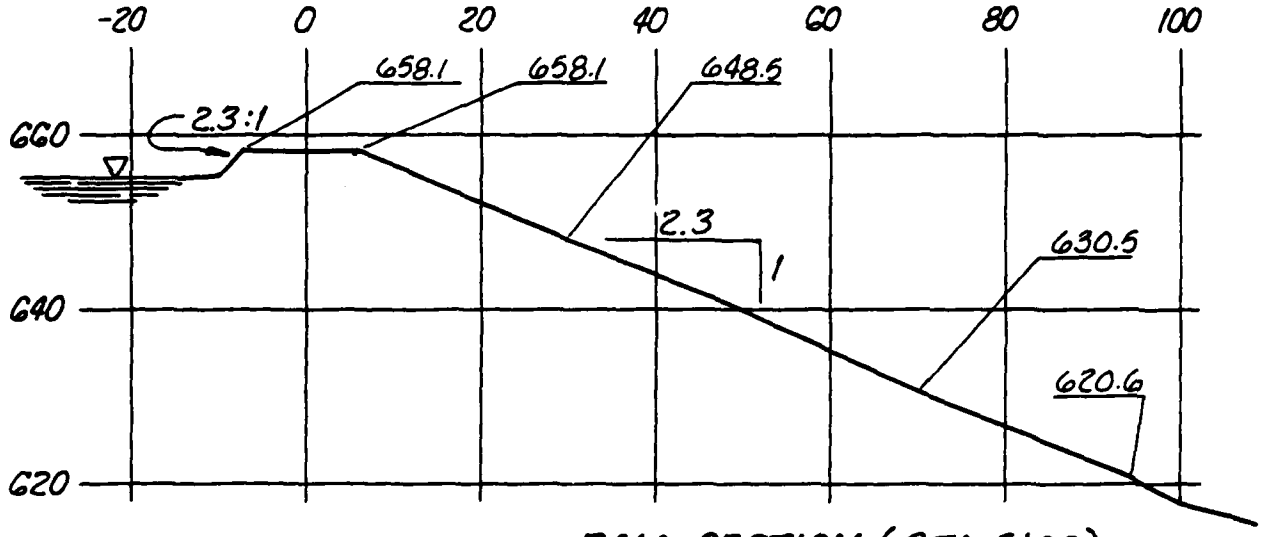
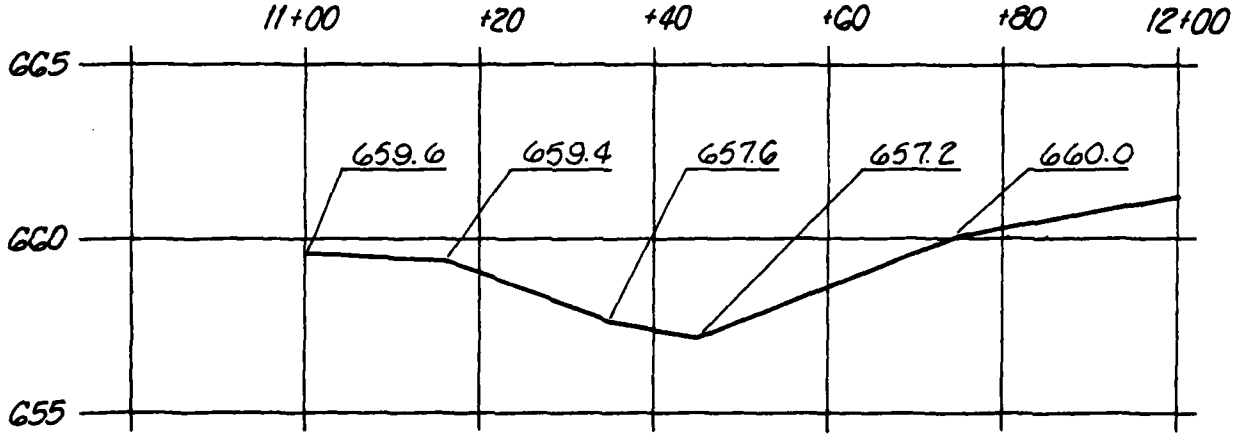

Cut
Concrete Slab & Culvert Control
Left Spillway Overbank
Old Channel
Spring Area
Seep Below Toe
Seep At Toe
Seep Area
Emergency Spillway
℄ Dam
Sta. 0+00 ℄ Dam
Sta 2+00 ℄ Dam
16'
2.5:1
2.5:1
Flow
Principle Spillway
Left Abutment
Right Abutment
N
PLAN OF DAM
Scale: 1" = 200'
0+00
2+00
4+00
6+00
8+00
10+00
12+00
657.4
658.4
658.8
659.0
658.3
658.1
658.3
658.4
658.6
659.0
658.9
659.0
659.6
660
655
Left Spillway Overbank
CENTERLINE PROFILE
Scale: 1" = 200' H
1" = 5' V

PLATE C-1



DAM SECTION (STA. 5+00)

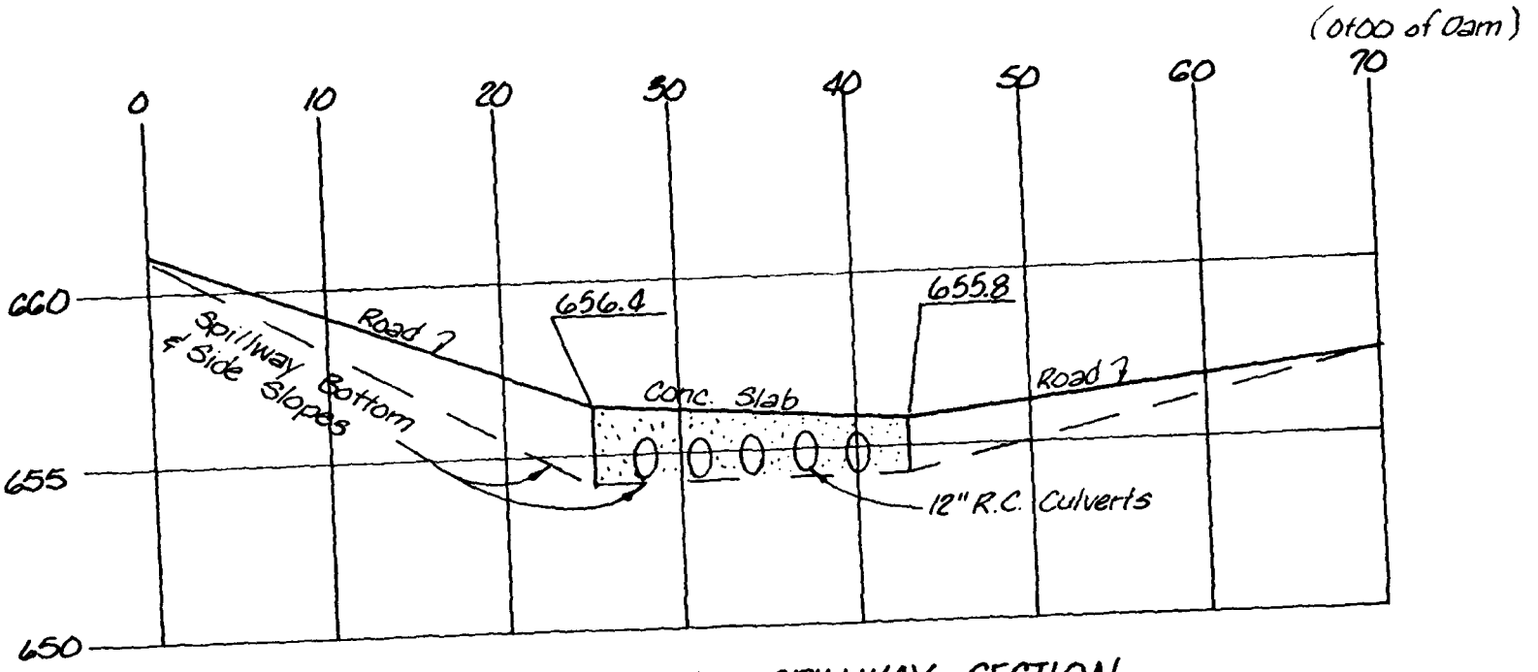
Scale: 1" = 20'



EMERGENCY SPILLWAY SECTION

Scale: 1" = 20' H.
1" = 5' V.

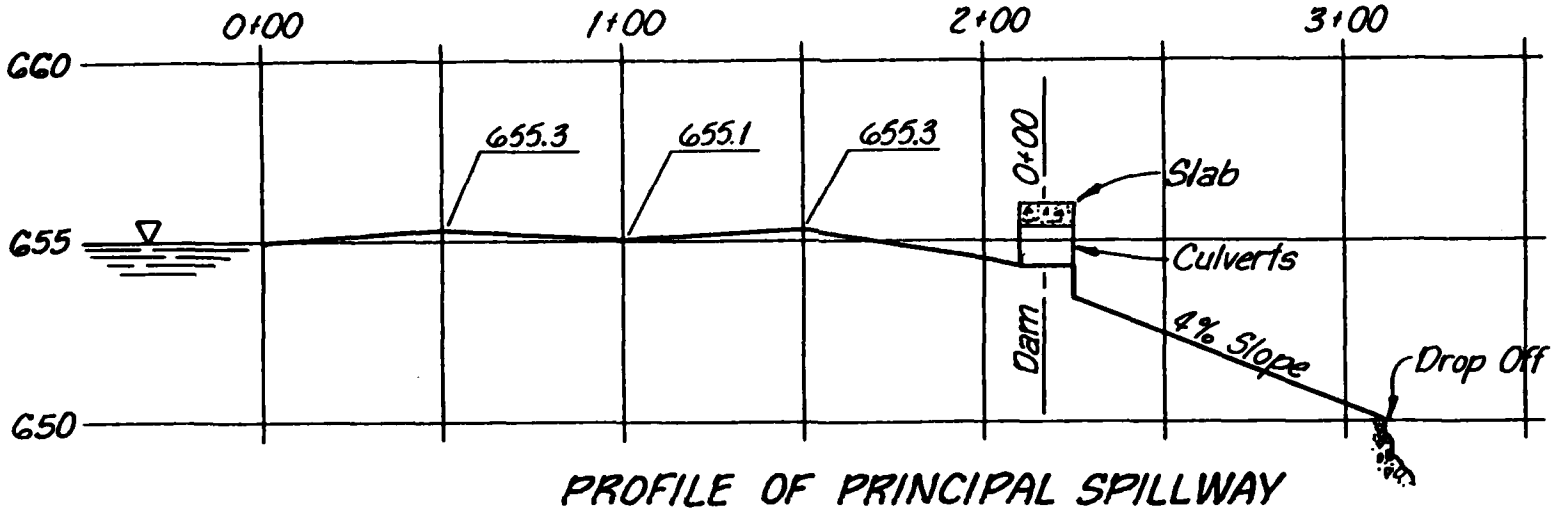
PLATE C-2



PRINCIPAL SPILLWAY SECTION

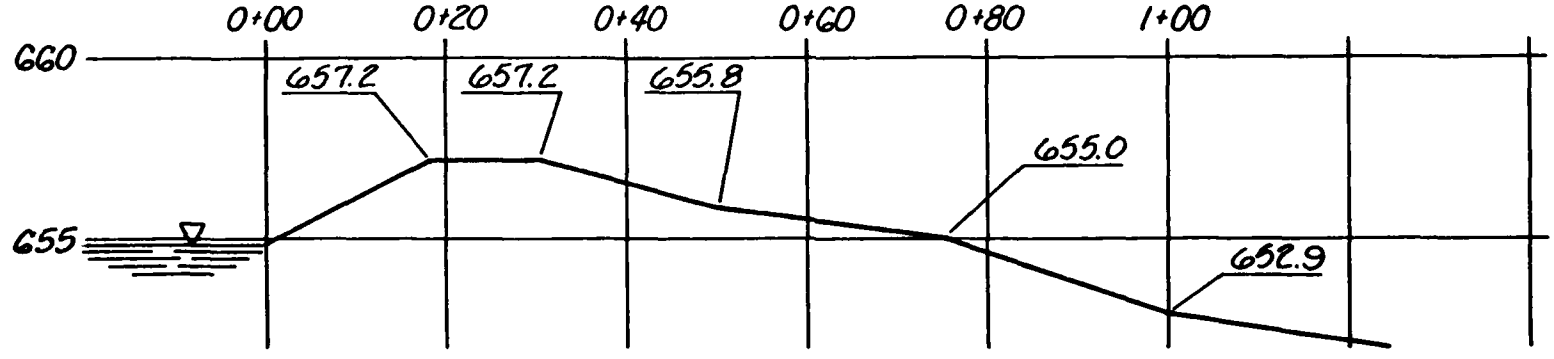
Scale : 1" = 10' H
1" = 5' V

PLATE C-3



PROFILE OF PRINCIPAL SPILLWAY

Scale: 1" = 50' H.
1" = 5' V.



PROFILE OF EMERGENCY SPILLWAY

Scale: 1" = 20' H.
1" = 5' V.

PLATE C-4

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (See Appendix D).

   a. Twenty-four hour, 100-year rainfall for the dam location was taken from the data for the rainfall station at Jefferson City, MO. as supplied by the St. Louis District, Corps of Engineers per their letter dated 6 March 1979. The twenty-four probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.96 square miles (616 acres).

   c. Time of concentration of runoff = 24 minutes (computed from "Kirpich" formula).

   d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the primary spillway crest.

   e. The total twenty-four hour storm duration losses for the 100-year storm were 3.45 inches. The total losses for the PMF storm were 2.03 inches. These data are based on SCS runoff curve No. 85 and No. 70 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil groups B, C, and D (Soil Association Union-Gass-Gasconade-Peridge) and consists entirely of wooded area.

   f. Average soil loss rates = 0.10 inch per hour approximately.

2. The discharge ratings for the principal spillway were developed using equations for weir and culvert flow, and channel flow. They are as follows:

   a. Weir flow equation ($Qw = CLH^{3/2}$)

Where C = weir coefficient = Varies with H (2.7 - 3.0)
L = length of weir, ft. = Varies with H.
H = total head, ft.

b. Culvert flows were taken from nomograph, "Headwater Depth for Concrete Pipe Culvert with Inlet Control", BPR, Jan. 1963.

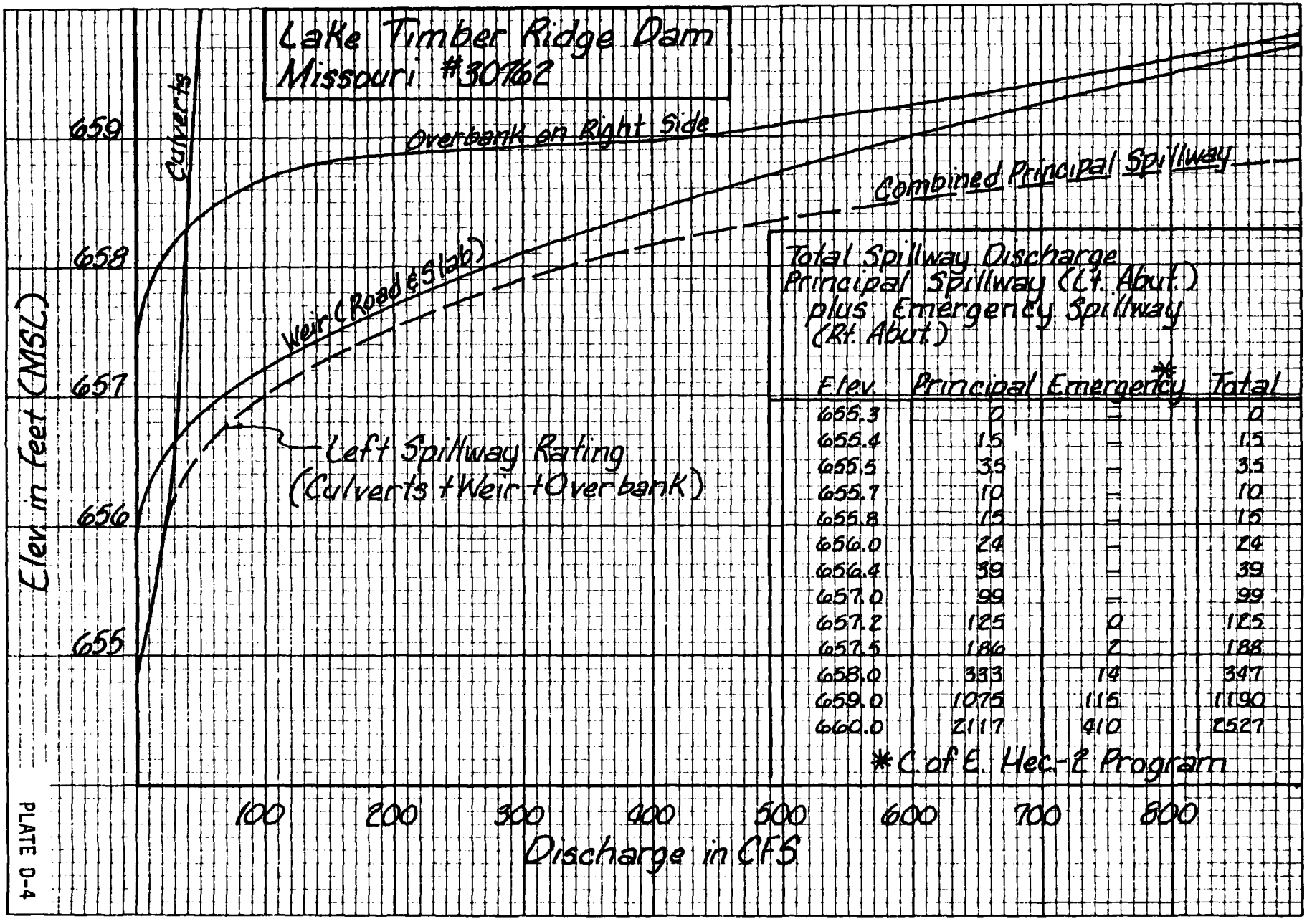
c. Channel spillway discharge ratings were developed using the HEC-2.

Channel conditions prevailed as the control from the principal spillway crest to 656 ft., and culvert plus weir control prevailed thereafter. The emergency spillway discharge rating was developed using the Corps of Engineers Surface Water Profile HEC-2 computer program and was added to the principal spillway discharge to give total spillway discharge. The flows over the dam crest were developed using the HEC-1 (Dam Safety Version) program with a discharge coefficient of 2.9 and a value of 1.5 for the exponent of head.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The output and plotted hydrographs are attached in this Appendix.

Lake Timber Ridge Dam
Missouri #07062
Principal Spillway
(Part)
Transition Curve
Channel to Weir Control
Channel
Channel-Weir-Overbank
Overbank
Discharge in CFS
Elev. in Feet (MSL)
0
10
20
30
40
50
60
70
80
954
956
958
960

PLATE D-3



Total Spillway Discharge
Principal Spillway (Lt. Abut.)
plus Emergency Spillway
(Rt. Abut.)

Elev	Principal	Emergency*	Total
655.3	0	—	0
655.4	1.5	—	1.5
655.5	3.5	—	3.5
655.7	10	—	10
655.8	15	—	15
656.0	24	—	24
656.4	39	—	39
657.0	99	—	99
657.2	125	0	125
657.5	186	2	188
658.0	333	14	347
659.0	1075	115	1190
660.0	2117	410	2527

* C. of E. Hec-2 Program

PLATE D-4

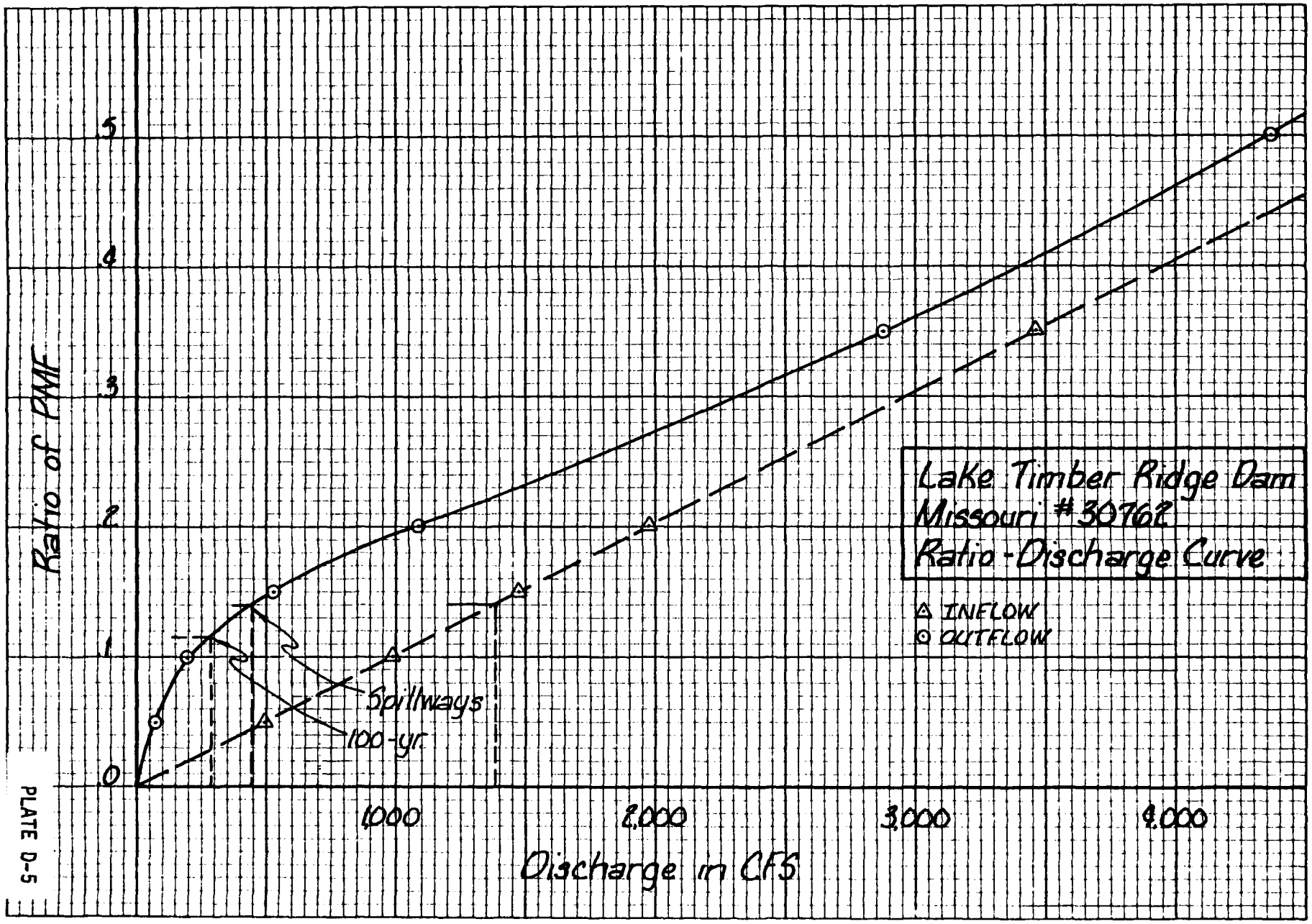

Lake Timber Ridge Dam
Missouri #30762
Ratio - Discharge Curve
△ INFLOW
⊙ OUTFLOW
Ratio of PMF
Discharge in CFS
0
1
2
3
4
5
1000
2000
3000
4000
Spillways
100-yr.

PLATE D-5

```
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE TIMBER RIDGE DAM 30762
A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
B 000288000000200000000005                              000000000000000000000001
B1000005
J 000001000000600000001
J1000,2000000,3500000,5000000,6500000,8000001.0
K 000000000000001                    000600020000000000000001
K1       CALCULATION OF INFLOW HYDROGRAPH TO RES 30762
M 000001000000200000.96          00000.96000001.0                    00000001
P        000025.40000010200000121000000130
T                                                    -1.0     -85.
W2       00000.24
X 000000-.01     00000001
K 000001000000002                    00000002          00000001
K1       ROUTED FLOWS THRU RES 30762
Y                        000000010000001
Y1000001                                             -655.3         -1
Y40655.3000655.4000655.5000655.7000655.8000656.0000656.4000657.0000657.2000657.5
Y40658.0000659.0000660.0
Y5000000000001.5000003.5000010.0000015.0000024.0000039.0000099.0000125.0000188.0
Y5 347.0  1191.0  2527.0
$S000000000002.5000070.0000220.0000480.0000668.0000899.0
$E0615.0000620.0000630.0000640.0000650.0000655.0000660.0
$B0655.3
$D 658.1     2.9     1.5   900.0
$L   200     315     445     525     563     800     900     900
$V 658.3   658.4   658.6   658.8   658.9   659.0   659.6   660.0
K 000099
A
A
A
A
A
```


PLATE D-6

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE= 79/07/18.
     TIME= 17.50.49.


                ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
                HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE TIMBER RIDGE DAM 30762
                RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

                                  JOB SPECIFICATION
          NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
         288        0        5        0        0        0        0        0        3        0
                                   JOPER      NWT   LROPT   TRACE
                                       5        0        0        0

                          MULTI-PLAN ANALYSES TO BE PERFORMED
                                NPLAN= 1 NRTIO= 6 LRTIO= 1
                RTIOS=    .20     .35     .50     .65     .80    1.00


**********      **********      **********      **********      **********

                                SUB-AREA RUNOFF COMPUTATION

                CALCULATION OF INFLOW HYDROGRAPH TO RES 30762

                          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                         000001       0       0       0       2       0       1       0       0

                                    HYDROGRAPH DATA
          IHYDG     IUHG    TAREA     SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1        2      .96     0.00     .96    1.00   0.000       0       1       1

                                      PRECIP DATA
                SPFE     PMS      R6      R12     R24     R48     R72     R96
                0.00   25.40  102.00   121.00  130.00    0.00    0.00    0.00

                                      LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0    0.00    0.00    1.00    0.00    0.00    1.00   -1.00  -85.00    3.00    0.00

          CURVE NO =  -85.00  WETNESS =   -1.00  EFFECT CN =   85.00

                                  UNIT HYDROGRAPH DATA
                              TC=  0.00    LAG=   .24

                                  RECESSION DATA
                              STRTQ=    0.00    QRCSN=    -.01    RTIOR= 1.00

          UNIT HYDROGRAPH 16 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=    .24  VOL= 1.00
          306.    1059.    1615.    1545.    1152.     670.     418.     258.     161.      98.
           61.      38.      23.      15.       9.       4.

0                                 END-OF-PERIOD FLOW
```

DVN

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1978.	521.	160.	160.	45948.
CMS	56.	15.	5.	5.	1301.
INCHES		5.05	6.18	6.18	6.18
MM		128.33	157.07	157.07	157.07
AC-FT		259.	316.	316.	316.
THOUS CU M		319.	390.	390.	390.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3462.	912.	279.	279.	80410.
CMS	98.	26.	8.	8.	2277.
INCHES		8.84	10.82	10.82	10.82
MM		224.59	274.87	274.87	274.87
AC-FT		452.	554.	554.	554.
THOUS CU M		558.	683.	683.	683.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4945.	1304.	399.	399.	114871.
CMS	140.	37.	11.	11.	3253.
INCHES		12.63	15.46	15.46	15.46
MM		320.84	392.67	392.67	392.67
AC-FT		646.	791.	791.	791.
THOUS CU M		797.	976.	976.	976.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6429.	1695.	519.	519.	149333.
CMS	182.	48.	15.	15.	4229.
INCHES		16.42	20.10	20.10	20.10
MM		417.09	510.48	510.48	510.48
AC-FT		840.	1028.	1028.	1028.
THOUS CU M		1037.	1269.	1269.	1269.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7912.	2086.	638.	638.	183794.
CMS	224.	59.	18.	18.	5204.
INCHES		20.21	24.74	24.74	24.74
MM		513.34	628.28	628.28	628.28
AC-FT		1034.	1266.	1266.	1266.
THOUS CU M		1276.	1561.	1561.	1561.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9890.	2607.	798.	798.	229742.
CMS	280.	74.	23.	23.	6506.
INCHES		25.26	30.92	30.92	30.92
MM		641.67	785.35	785.35	785.35
AC-FT		1293.	1582.	1582.	1582.
THOUS CU M		1595.	1952.	1952.	1952.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED FLOWS THRU RES 30762

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-655.	-1

STAGE	655.30	655.40	655.50	655.70	655.80	656.00	656.40	657.00	657.20	657.59
	658.00	659.00	660.00							
FLOW	0.00	1.50	3.50	10.00	15.00	24.00	39.00	99.00	125.00	188.00
	347.00	1190.00	2527.00							
CAPACITY=	0.	3.	70.	220.	480.	668.	899.			
ELEVATION=	615.	620.	630.	640.	650.	655.	663.			

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
655.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
658.1	2.9	1.5	900.

CREST LENGTH	200.	315.	445.	525.	563.	800.	900.	900.
AT OR BELOW ELEVATION	658.3	658.4	658.6	658.8	658.9	659.0	659.6	660.0

STATION 000002, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PLATE D-9

LIVN

STATION 000002, PLAN 1, RATIO 6 PMF

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	2.	2.
2.	2.	2.	2.	3.	3.	3.	4.	6.	7.
8.	9.	11.	13.	15.	17.	19.	22.	24.	26.
27.	29.	31.	33.	35.	37.	39.	44.	49.	54.
59.	64.	69.	74.	79.	84.	89.	94.	99.	105.
111.	117.	123.	132.	141.	150.	159.	168.	176.	184.
194.	206.	217.	227.	238.	247.	257.	266.	274.	283.
291.	298.	306.	313.	319.	326.	332.	338.	344.	352.
365.	377.	387.	396.	407.	428.	468.	531.	609.	717.
846.	976.	1097.	1201.	1286.	1353.	1407.	1456.	1510.	1569.
1630.	1686.	1733.	1771.	1801.	1824.	1841.	1854.	1866.	1891.
1938.	2016.	2100.	2175.	2234.	2278.	2309.	2331.	2346.	2357.
2355.	2331.	2302.	2328.	2473.	2851.	3765.	5541.	7722.	9085.
9054.	8041.	6750.	5592.	4652.	3932.	3405.	3031.	2774.	2598.
2478.	2394.	2337.	2298.	2269.	2233.	2174.	2098.	2018.	1949.
1900.	1863.	1835.	1813.	1798.	1787.	1767.	1706.	1574.	1385.
1183.	1001.	854.	740.	653.	589.	540.	495.	456.	418.
386.	357.	341.	332.	323.	315.	307.	299.	292.	285.
278.	272.	266.	260.	254.	249.	244.	239.	235.	231.
226.	223.	219.	215.	212.	208.	205.	202.	200.	197.
194.	192.	189.	188.	186.	185.	183.	182.	181.	180.
178.	177.	176.	175.	174.	173.	172.	171.	170.	169.
168.	168.	167.	166.	165.	164.	164.	163.		

STORAGE

682.	682.	682.	682.	682.	682.	682.	682.	682.	682.
682.	682.	682.	682.	682.	682.	682.	682.	682.	682.
682.	682.	682.	682.	682.	682.	682.	682.	682.	682.
682.	682.	682.	682.	682.	682.	682.	682.	682.	682.
682.	682.	682.	683.	683.	683.	683.	683.	683.	683.
683.	684.	684.	684.	684.	684.	684.	685.	685.	685.
685.	685.	686.	686.	686.	686.	686.	687.	687.	687.
687.	688.	688.	688.	689.	690.	691.	692.	694.	696.
697.	699.	701.	703.	705.	707.	709.	712.	714.	716.
718.	721.	723.	725.	728.	730.	732.	735.	737.	740.
742.	744.	747.	749.	751.	754.	756.	758.	76..	763.
765.	767.	769.	771.	773.	775.	777.	779.	781.	783.
784.	786.	788.	787.	791.	792.	794.	795.	796.	797.
798.	800.	801.	802.	803.	804.	804.	805.	806.	807.
808.	808.	809.	809.	810.	811.	813.	817.	821.	825.
830.	833.	836.	839.	841.	842.	843.	844.	845.	846.
848.	849.	849.	850.	851.	851.	851.	851.	852.	852.
853.	854.	855.	856.	857.	857.	857.	858.	858.	858.
858.	858.	857.	858.	859.	864.	873.	889.	905.	915.
915.	908.	898.	889.	881.	875.	869.	866.	863.	861.
859.	859.	858.	857.	857.	857.	856.	855.	854.	853.
852.	852.	851.	851.	851.	850.	850.	849.	847.	843.
838.	834.	830.	826.	823.	820.	817.	815.	812.	810.
809.	807.	806.	804.	803.	802.	801.	800.	799.	798.

```
      797.        796.        795.        794.        793.        792.        792.        791.        790.        790.
      789.        789.        788.        787.        787.        786.        786.        786.        785.        785.
      784.        784.        784.        783.        783.        783.        782.        782.        782.        782.
      781.        781.        781.        781.        780.        780.        780.        780.        780.        779.
      779.        779.        779.        779.        778.        778.        778.        778.

                                                 STAGE
     655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3
     655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3
     655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3
     655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3
     655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3       655.3
     655.3       655.3       655.3       655.3       655.3       655.4       655.4       655.4       655.4       655.4
     655.4       655.4       655.4       655.4       655.4       655.4       655.4       655.4       655.4       655.4
     655.4       655.4       655.4       655.4       655.5       655.5       655.5       655.5       655.6       655.6
     655.6       655.7       655.7       655.8       655.8       655.9       655.9       655.9       656.0       656.0
     656.1       656.1       656.2       656.2       656.3       656.3       656.4       656.4       656.5       656.5
     656.6       656.7       656.7       656.8       656.8       656.9       656.9       656.9       657.0       657.0
     657.1       657.1       657.2       657.2       657.3       657.3       657.4       657.4       657.4       657.5
     657.5       657.6       657.6       657.6       657.7       657.7       657.7       657.7       657.8       657.8
     657.8       657.8       657.9       657.9       657.9       657.9       658.0       658.0       658.0       658.0
     658.0       658.0       658.0       658.1       658.1       658.1       658.1       658.2       658.3       658.4
     658.5       658.6       658.6       658.7       658.7       658.8       658.8       658.8       658.8       658.9
     658.9       658.9       658.9       658.9       659.0       659.0       659.0       659.0       659.0       659.0
     659.0       659.0       659.0       659.1       659.1       659.1       659.1       659.1       659.1       659.1
     659.1       659.1       659.1       659.1       659.1       659.2       659.4       659.8       660.1       660.3
     660.3       660.2       660.0       659.8       659.6       659.5       659.4       659.3       659.2       659.2
     659.1       659.1       659.1       659.1       659.1       659.1       659.1       659.0       659.0       659.0
     659.0       659.0       659.0       659.0       659.0       658.9       658.9       658.9       658.9       658.8
     658.7       658.6       658.5       658.4       658.4       658.3       658.2       658.2       658.1       658.1
     658.0       658.0       658.0       658.0       657.9       657.9       657.9       657.8       657.8       657.8
     657.8       657.8       657.7       657.7       657.7       657.7       657.7       657.7       657.6       657.6
     657.6       657.6       657.6       657.6       657.6       657.6       657.6       657.5       657.5       657.5
     657.5       657.5       657.5       657.5       657.5       657.5       657.5       657.5       657.5       657.5
     657.5       657.4       657.4       657.4       657.4       657.4       657.4       657.4       657.4       657.4
     657.4       657.4       657.4       657.4       657.4       657.4       657.4       657.4

PEAK OUTFLOW IS      9085. AT TIME  15.83 HOURS

                                         PEAK    6-HOUR    24-HOUR    72-HOUR   TOTAL VOLUME
                               CFS       9085.    2571.      749.       749.        215768.
                               CMS        257.      73.       21.        21.          6110.
                            INCHES                24.92     29.04      29.04         29.04
                                MM               632.85    737.58     737.58        737.58
                             AC-FT                1275.     1486.      1486.         1486.
                         THOUS CU M               1573.     1833.      1833.         1833.
```

PLATE D-11

DVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

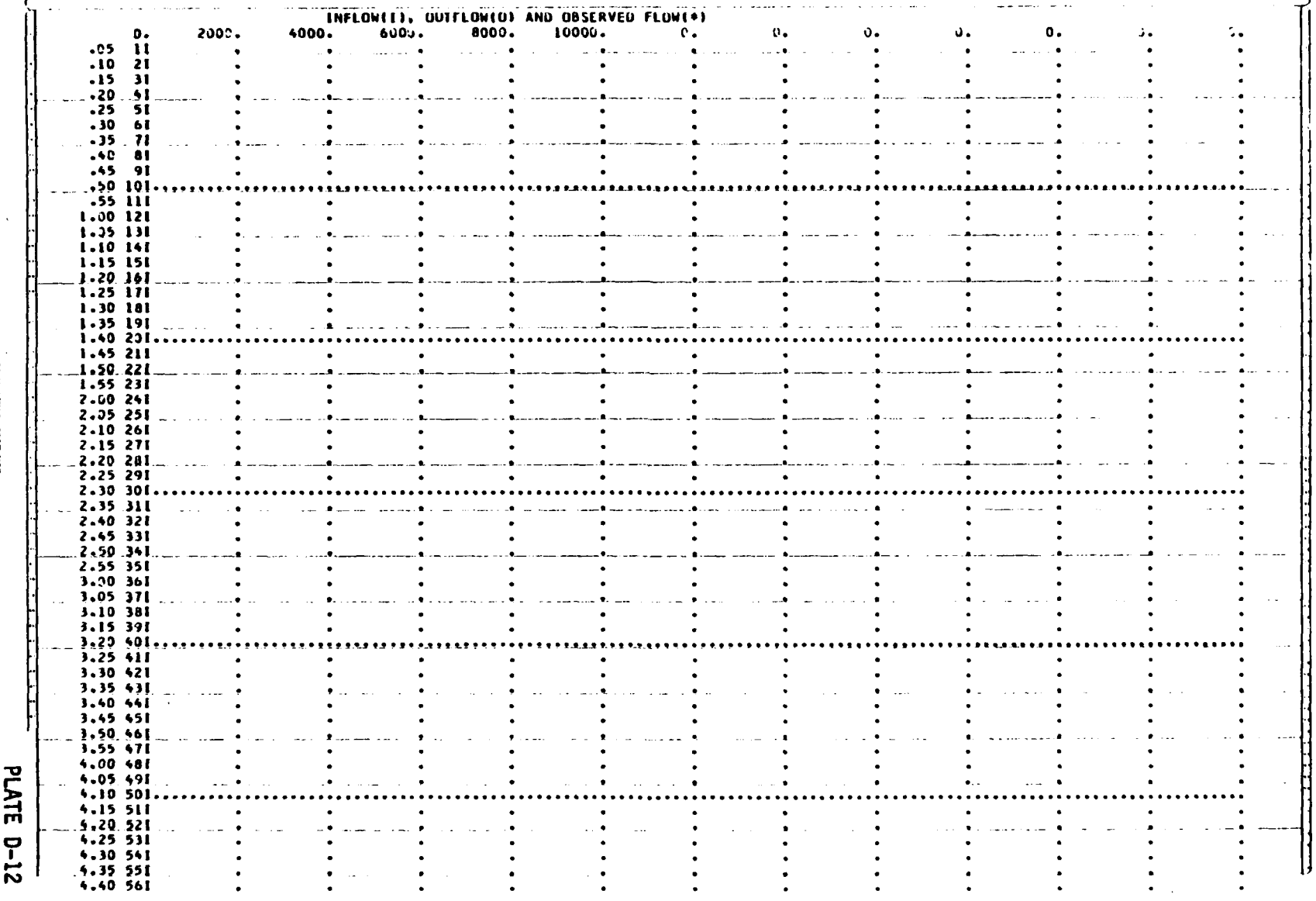


PLATE D-12

PLATE D-13

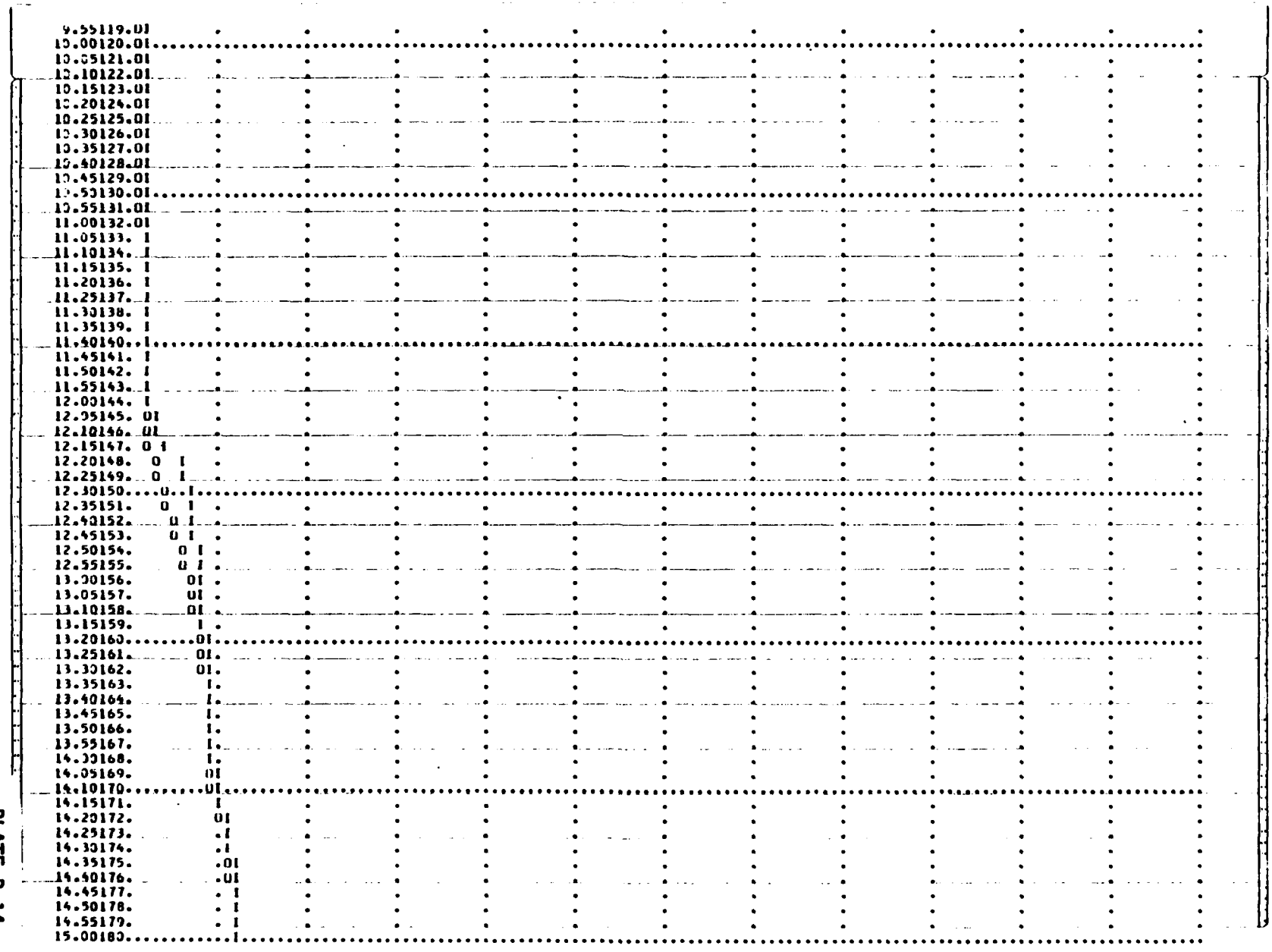


PLATE D-14

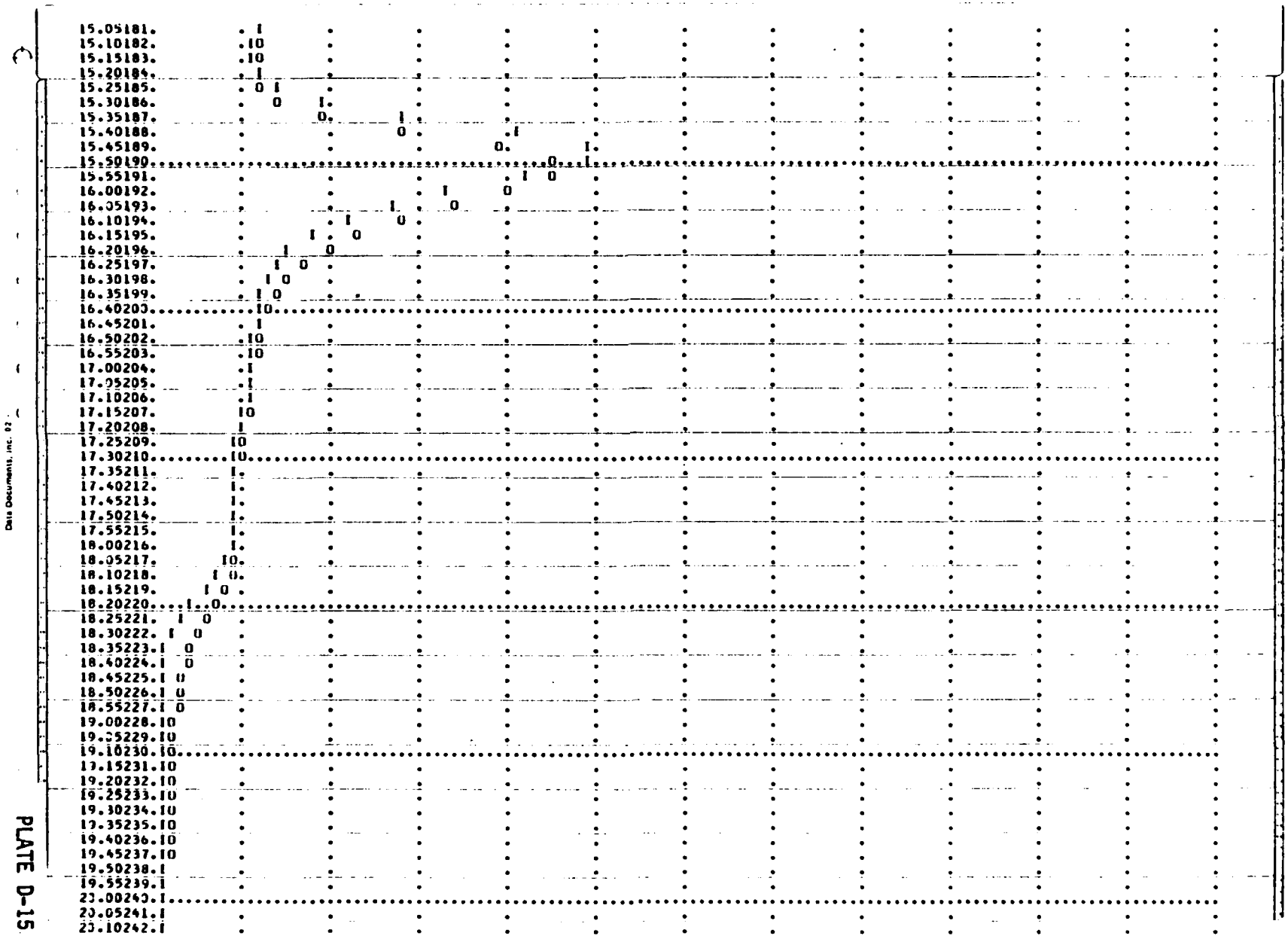


PLATE D-15

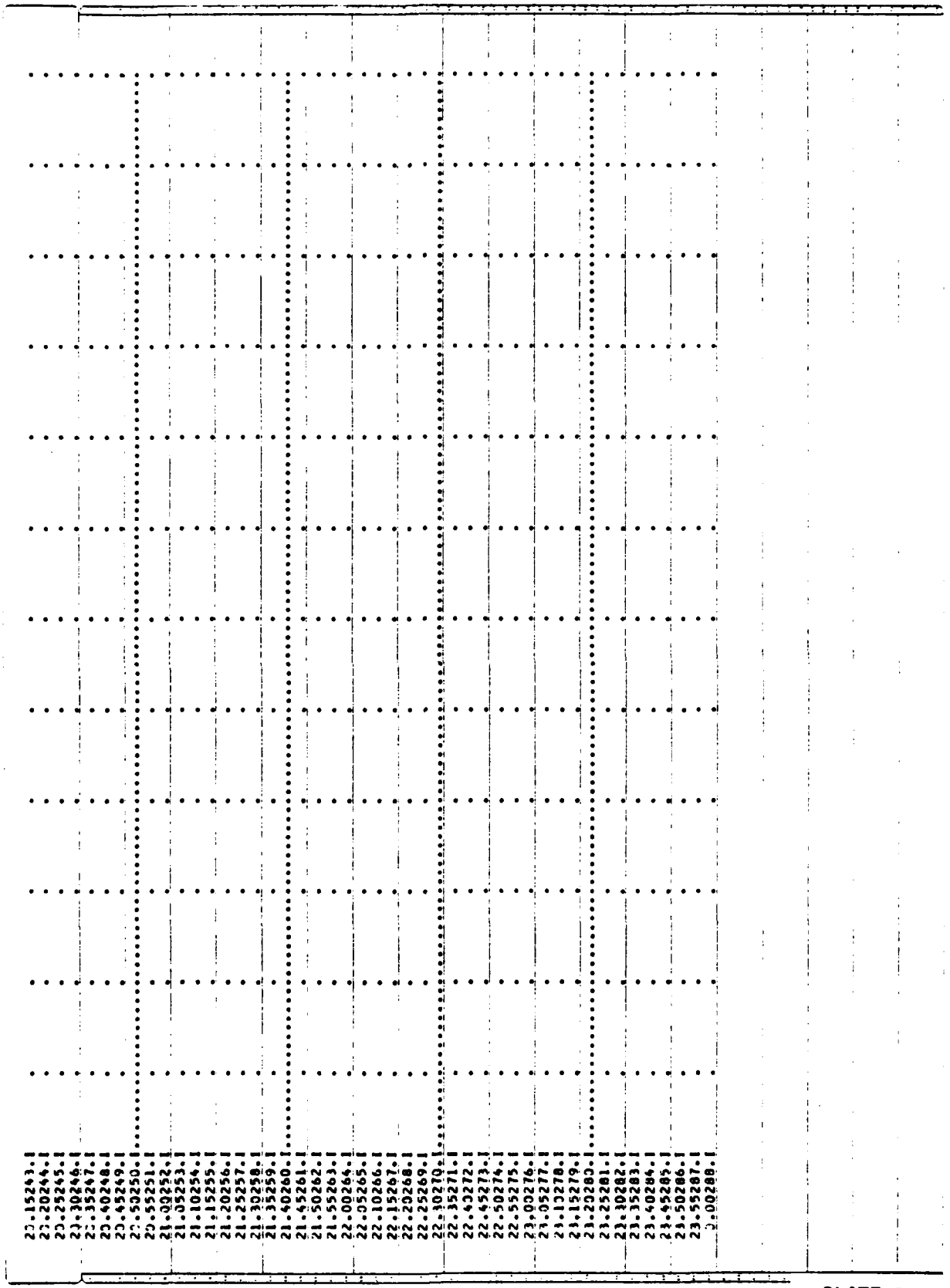


PLATE D-16

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS					
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
				.20	.35	.50	.65	.80	1.00
HYDROGRAPH AT	000001	.96	1	1978.	3462.	4945.	6429.	7912.	9890.
		(2.49)	(	56.01)(	98.02)(	140.03)(	182.04)(	224.05)(	280.07)(
ROUTED TO	000002	.96	1	1091.	2880.	4370.	5795.	7198.	9085.
		(2.49)	(	30.90)(	81.54)(	123.74)(	164.09)(	203.82)(	257.25)(

PLATE D-17

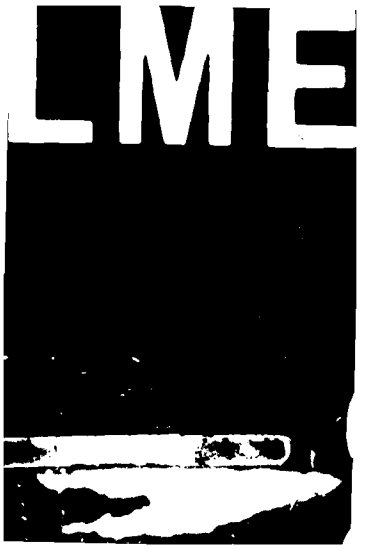
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	655.30	655.30	658.10
STORAGE	682.	682.	811.
OUTFLOW	0.	0.	431.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	658.64	.54	836.	1091.	2.17	16.08	0.00
.35	659.24	1.14	864.	2880.	4.25	15.92	0.00
.50	659.56	1.46	879.	4370.	5.42	15.92	0.00
.65	659.82	1.72	891.	5795.	6.17	15.92	0.00
.80	660.05	1.95	901.	7198.	6.50	15.92	0.00
1.00	660.35	2.25	915.	9085.	6.92	15.83	0.00

PLATE D-18


LME